STATE OF NEW YORK
CONSERVATION DEPARTMENT
WATER RESOURCES COMMISSION

A PRELIMINARY ANALYSIS OF LOW FLOWS AT SELECTED SITES IN THE SOUTHERN PART OF THE TOWN OF BETHLEHEM, NEW YORK

By

OLIVER P. HUNT AND ROBERT M. BEALL
U.S. GEOLOGICAL SURVEY

REPORT OF INVESTIGATION
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Prepared by
UNITED STATES DEPARTMENT OF THE INTERIOR
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in cooperation with
TOWN OF BETHLEHEM

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INTRODUCTION

During the fiscal year ending June 1967, the Town of Bethlehem, New York, entered into a cooperative agreement with the U.S. Geological Survey for investigation of the low-flow characteristics of the following stream sites in and near the town:

Vloman Kill at Jericho Road at Mallorys Corners
Vloman Kill at Highway 144 at Cedar Hill
South Albany Creek near mouth near South Bethlehem
Coeymans Creek at Highway 396 near South Bethlehem
Coeymans Creek near Interstate Route 87 near Coeymans

This is an area where residential and industrial development is taking place, and where a better understanding of the water resources is needed.

A series of streamflow measurements was made at each of the sites during the summer and fall of 1966 and the summer of 1967. This report contains an evaluation of the magnitude and frequency of recurrence of low flows at each of the specified sites and at three other sites where sufficient data had been obtained through other investigative programs. In addition, the report lists results of discharge measurements made at 18 sites in the Vloman Kill and Coeymans Creek basins since 1952.

The report concerns an area of about 75 square miles, of which about 30 square miles are in the Vloman Kill basin and about 45 square miles are in the Coeymans Creek basin (fig. 1). Both basins are directly tributary to the Hudson River estuary and are in southeastern Albany County. The area includes parts of the Towns of Bethlehem, Coeymans, and New Scotland. South Albany Creek is tributary to Onesquethaw Creek about a mile east of South Bethlehem and there forms Coeymans Creek.

Most of the data included and interpreted in this report were collected in the southern part of the Town of Bethlehem.

STREAMFLOW

Streamflow from a basin usually originates as precipitation on the basin but is modified or influenced by many factors including: season of the year, soil characteristics and conditions, geology, topography, and manmade changes.

The Source - Precipitation

U.S. Weather Bureau precipitation records for the City of Albany have been used to illustrate the annual variability of the source of supply. Precipitation for each year 1930-66 is shown in the bar graph, figure 2. Also shown are the extremes and average of annual precipitation for the 141-year period 1826-1966.

All streamflow measurements used in the evaluation of low-flow characteristics were made under base-flow conditions; that is, during periods when the yield is sustained by ground-water outflow, after the immediate effects of storm runoff have passed. In general, this ground-water outflow may be expected to follow the dominant precipitation trends; therefore, base flows are higher in wet years and lower in dry years.

Most of the streamflow data for the five principal study sites were collected during the period of recovery from the severe drought of 1962-65. The carryover effects of that drought were particularly evident in the low flows of Coeymans Creek near South Bethlehem where a few measurements had been obtained prior to and during the drought. Recovery of expected streamflow levels in response to near normal rainfall is apparently delayed in this sand-plain area due to depletion of ground-water storage in the underlying glacial lake deposits. Such a depletion must be restored before normal ground-water outflow to the streams can occur.

Geography and Geology - In Brief

The Vloman Kill basin and the Coeymans Creek basin east of South Bethlehem have gently rolling hills on a plain which is, for the most part, 150 to 200 feet above sea level. The principal streams lie in narrow valleys about 50 feet lower than the general plain elevation and have low gradients. Much of the area is underlain by glacial lake deposits of very low transmissibility. Recent alluvium occurs along many of the stream channels.

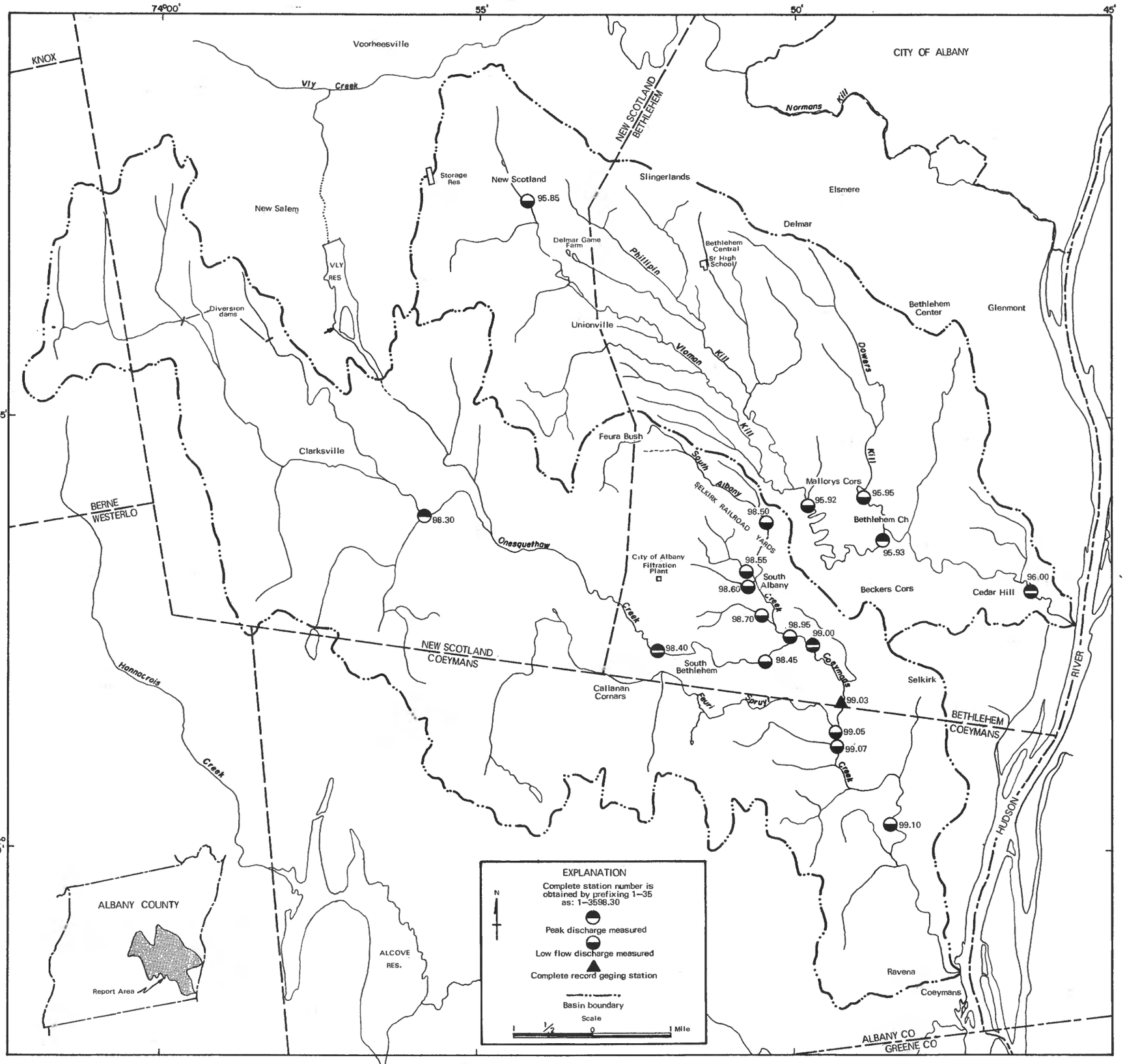


Figure 1.--Map showing drainage system and streamflow measurement sites, Vloman Kill and Coeymans Creek basins, Albany County, N. Y.

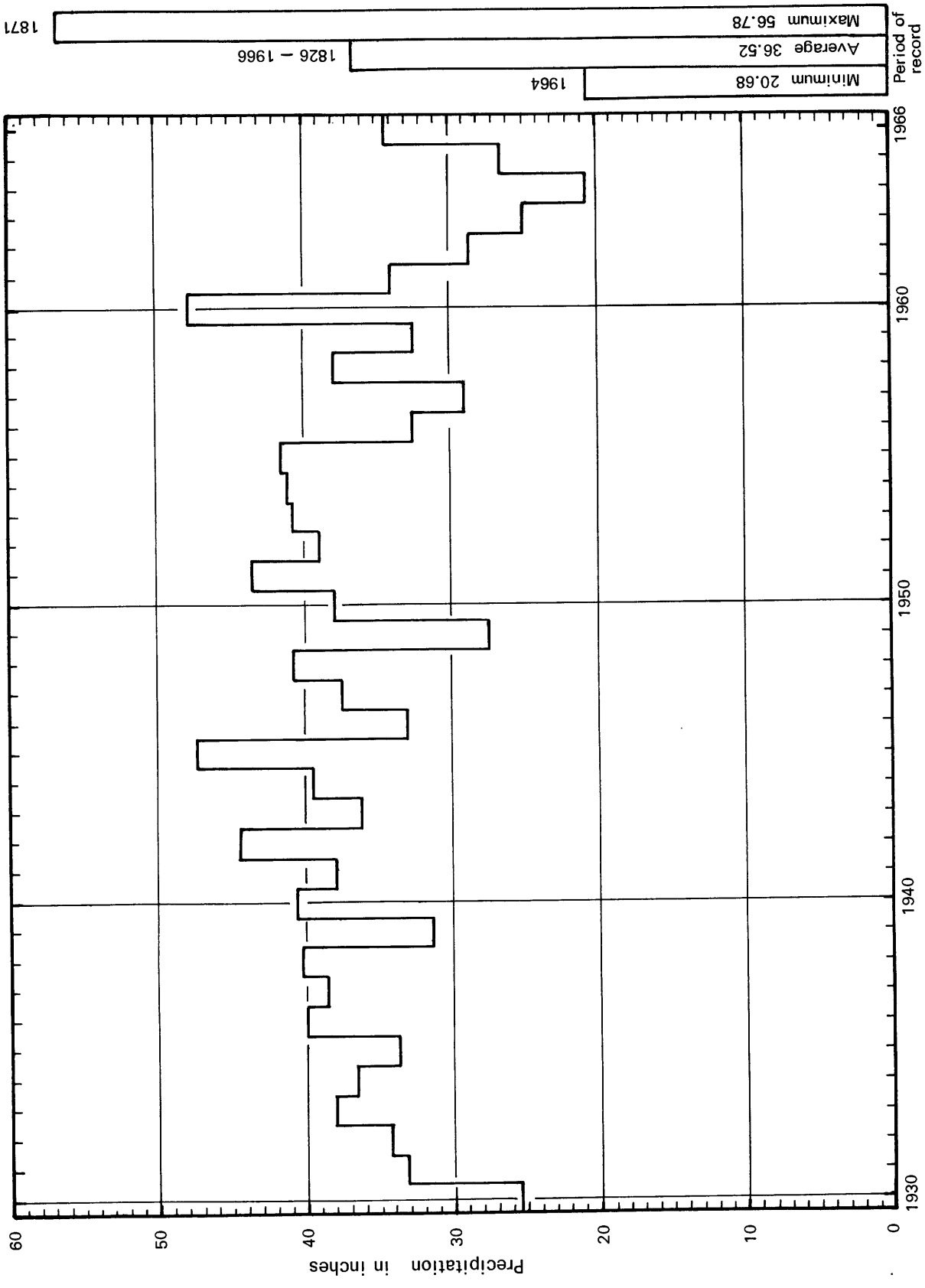


Figure 2.--Graph of annual precipitation, 1930-66, at Albany, N. Y. and summary for the period 1826-1966.

The Onesquethaw Creek basin (Coeymans Creek basin west of the mouth of South Albany Creek) is an area of greater relief in which the Helderberg hills of more than 1,000 feet in elevation south and west of Clarksville drain to an irregular valley 300 to 400 feet above sea level. Glacial till, an unsorted mixture of rock debris of low permeability, is the predominate surficial deposit in this part of the area. The till is thin near the southern and western boundary of the basin where shale and limestone bedrock crop out in many places. Stream gradients are relatively steep, particularly in the small headwater tributaries.

The source and occurrence of ground water in Albany County and the geology and water-bearing properties of the formations were described by Theodore Arnow in 1949 in a report entitled: "The Ground-Water Resources of Albany County, New York," prepared by the U.S. Geological Survey and published (as Bulletin GW-20) by the New York Water Power and Control Commission.

Cultural Influences

Streamflows in both the Vloman Kill and Coeymans Creek basins are modified to some extent by a variety of activities of the occupants of the basins. None of the modifications have been measured on a continuing basis; only a few have been quantitatively observed.

The construction of Vly Reservoir in 1954 by Bethlehem Water District No. 1 impounded the outflow from a small headwater area formerly tributary to Onesquethaw Creek. Most of this water, with that from the Vly Creek tributary area also impounded, is transported to the Slingerlands-Delmar-Elsmere area and, after use, is eventually discharged into the Normans Kill basin. Some, no doubt, finds its way into the northern tributaries of the Vloman Kill by drainage from areas served by septic tanks. Since 1964, water has been diverted (from October through April, only) from two streams in the headwaters of Onesquethaw Creek to Vly Reservoir, supplementing the impounded supply there.

Backwash water from the City of Albany filtration plant is frequently discharged to Onesquethaw Creek at a point about a mile west of South Bethlehem. Estimates of this discharge made in 1955, 1961, and 1965 ranged from 0.5 cfs (cubic feet per second) to more than 5 cfs. It is now recorded as an addition to the natural flow at the gaging station 4 miles downstream. This water originates in Albany's Alcove-Basic Reservoir system, south of the Onesquethaw basin.

The village of Ravena, which obtains its water supply from Hannacrois Creek, discharges primary-treated sewage effluent at a rate of about 0.4 cfs into Coeymans Creek at a point about a mile upstream from the mouth. Untreated effluent is discharged to the creek at other points.

A very small amount of effluent, probably less than 0.02 cfs, is discharged into South Albany Creek from a private sewer system in South Albany after nominal tertiary treatment. Industrial wastes from the Selkirk railroad yards are lagooned but, at times, are washed into South Albany Creek.

Bethlehem Central Senior High School discharges a small amount, usually less than 0.04 cfs, of tertiary-treated sewage effluent into an unnamed small tributary to Phillipin Kill in the Vloman Kill basin.

Other unmeasured activities which have some effect on surface-water discharge include farm ponds and similar impoundments, manipulation of the storage in the Delmar Game Farm ponds, diversions for irrigation, and residential, industrial, and highway development.

STREAMFLOW DATA

Since 1952, a total of 124 discharge measurements have been made in the report area. Results of all measurements made prior to October 1967 are listed as an appendix to this report. Data for 18 sites are tabulated, 5 in the Vloman Kill basin and 13 in the Coeymans Creek basin. (See figure 1.) Five measurements of peak discharge are included, as well as 13 observations of no flow or just a trace of flow. Most of the remainder represent discharge under base-flow conditions and, where available in sufficient numbers, can be used to evaluate some characteristics of low-flow yield at the particular site. Prior to 1966, 78 discharge measurements had been made under a variety of cooperative agreements with State agencies. The 46 measurements made during 1966 and 1967 were made under the agreement with the Town of Bethlehem.

A continuous record stream-gaging station was established August 28, 1967, under a financial cooperative agreement with the City of Albany, on Coeymans Creek at Pictuay Road, a mile west of Selkirk. In time, the data at this site will be useful for evaluating basin streamflow characteristics and in measuring the inflow to the basin from the filtration plant near South Bethlehem.

MAGNITUDE AND FREQUENCY OF LOW FLOW

Low-flow yield and frequency data help to determine whether a water-utilization project is economically feasible and whether it can be operated without providing storage. The data are useful also for defining the chance of occurrence of flows not sufficient to dilute industrial or domestic wastes to acceptable levels.

The annual lowest average flow for 7 consecutive days is used as the basic low-flow statistic in preference to the annual lowest average daily flow. Daily flows can be disrupted in a variety of ways but the average of those for a week are much less likely to be manipulated except by some permanent facility.

At eight of the sites in the report area, a sufficient number of discharge measurements has been made to permit approximation of the magnitude of the annual minimum 7-day flow to be expected 1 year out of 2, on the average, and also 1 year out of 10, on the average. The low-flow frequency characteristics of the eight sites were determined by correlating a range of base-flow discharges at each site with that of contemporaneous discharges at two or more nearby complete-record gaging stations where the frequency characteristics of flow have been defined. This procedure assumes that the frequency characteristics at the gaging station apply at the measuring site, a valid assumption within a limited area.

Results of correlation and analysis for the eight sites in the report area are shown below.

Station number (figure 1)	Stream name and location	Lowest annual average consecutive 7-day discharge, in cubic feet per second, for indicated recurrence intervals	
		2-year	10-year
1-3595.85	Vloman Kill at New Scotland (drainage area, 2.55 square miles)	0.25	0.15
1-3595.92	Vloman Kill at Mallorys Corners	.05	Trace
1-3595.95	Dowers Kill near Selkirk	0	0
1-3596.00	Vloman Kill at Cedar Hill (drainage area, 29.8 square miles)	.10	0
1-3598.95	South Albany Creek near South Bethlehem	.25	.20
1-3599.00	Coeymans Creek at South Bethlehem (drainage area, 34.6 square miles)	*1.5	*1.0
1-3599.05	Feuri Spruyt near South Bethlehem	.40	.20
1-3599.10	Coeymans Creek near Coeymans	*1.7	*1.1

* Data subject to revision when magnitude and frequency of inflow have been evaluated.

THE FUTURE

This study has developed an appreciation for the many factors that can have an effect on the flow characteristics of these two basins. Future studies will be keyed to the data being accumulated at the new Coeymans Creek gaging station. A similar station on Vloman Kill would be quite useful. A systematic program of measurements at selected sites could identify tributary areas of significant flow contribution and also stream reaches where significant losses occur. Such information is essential to the planning and engineering procedures that result in optimum development of the town and region.

SELECTED REFERENCES

Arnow, Theodore, 1949, The ground-water resources of Albany County, New York: New York Water Power and Control Comm. Bull. GW-20, 56 p.

Halberg, H. N., Hunt, O. P., and Pauszek, F. H., 1964, Water resources of the Albany-Schenectady-Troy area, New York: U.S. Geol. Survey Water-Supply Paper 1499-D, 64 p.

New York State Department of Health, 1962, Recommended classifications and assignment of standards of quality and purity for designated waters of New York State: Lower Hudson River Basin Survey Ser. Rept. No. 11, drainage basins of streams entering the Hudson River in Albany, Columbia, Greene, and Rensselaer Counties, 243 p.

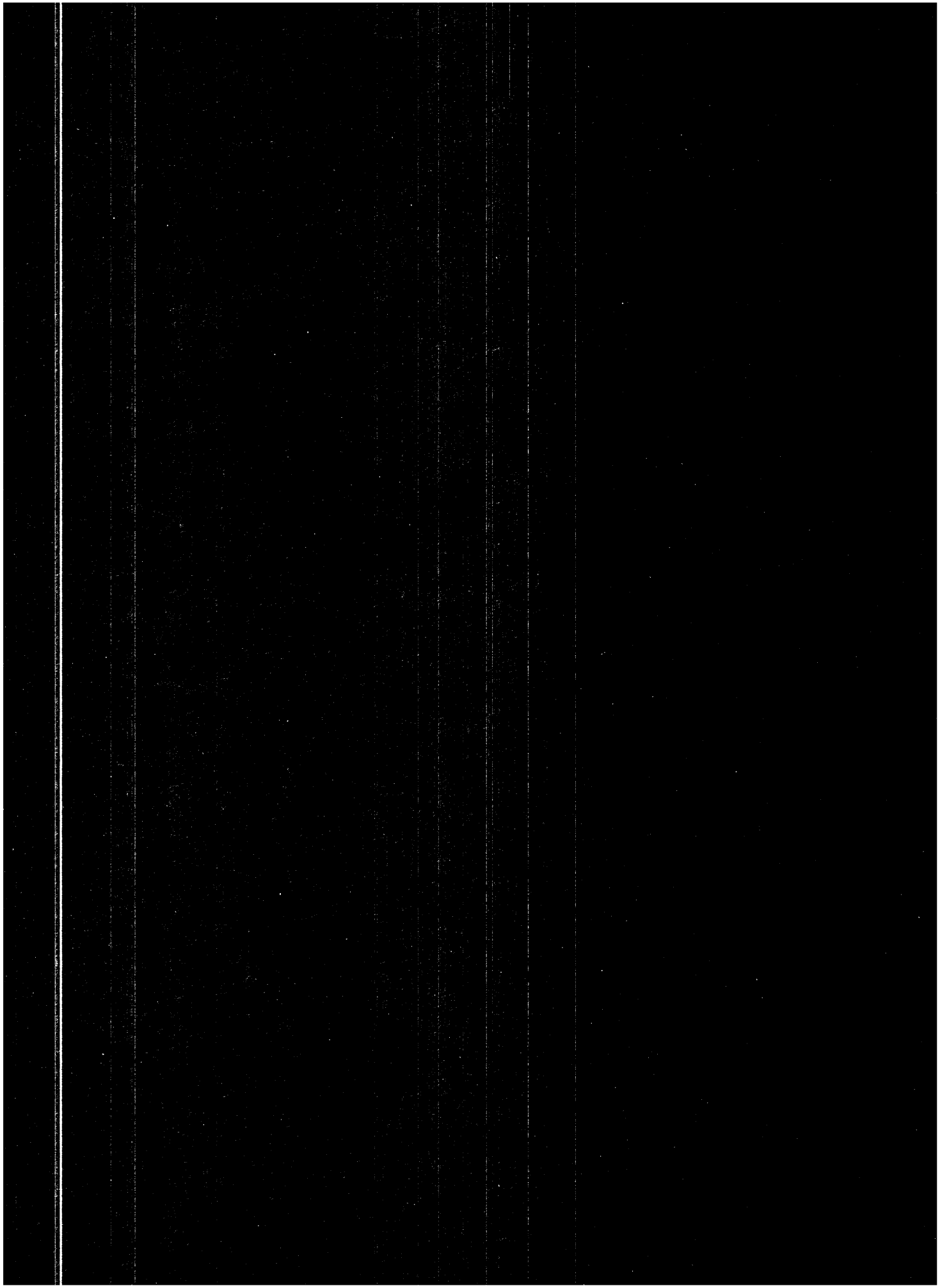
APPENDIX

Discharge measurements made at miscellaneous sites in the Vloman Kill and Coeymans Creek basins, Albany County, N. Y.

Station No.	Station name	Location	Measurements	
			Date	Discharge (cfs)
1-3595.85	Vloman Kill at New Scotland	70 ft downstream from bridge on farm road, 0.5 mile south of New Scotland. (Drainage area, 2.55 square miles.)	8/29/62	0.36
			6/27/63	.38
			8/23/63	.26
			9/ 5/63	.25
			7/24/64	.16
			7/28/64	.12
1-3595.92	Vloman Kill at Mallorys Corners	at bridge on Jericho Road, 0.25 mile west of Mallorys Corners.	9/ 8/65	.08
			9/29/65	.40
			10/21/65	.43
			6/24/66	.22
			7/14/66	.03
			7/26/66	.04
			8/10/66	.03
			8/26/66	.09
			9/12/66	.13
			10/10/66	.39
			6/ 7/67	1.46
			9/ 7/67	.29
1-3595.93	Vloman Kill at Bethlehem Church	at bridge on Elm Avenue, 0.3 mile southwest of Bethlehem Church. (Drainage area, 19.7 square miles.)	4/ 5/52	m 1,520
1-3595.95	Dowers Kill near Selkirk	at bridge on Jericho Road, 0.6 mile east of Elm Avenue, 0.7 mile upstream from mouth, and 2.6 miles north of Selkirk.	8/22/62	.04
			6/27/63	.02
			7/12/63	0
			9/ 5/63	0
			5/ 5/64	.89
			9/ 8/65	0
			9/29/65	.07
			10/21/65	.15
1-3596	Vloman Kill at Cedar Hill, near Selkirk	at bridge on State Highway 144, at Cedar Hill, near Selkirk. (Drainage area, 29.8 square miles.)	4/ 5/52	m 3,440
			5/20/54	5.20
			8/27/54	.54
			9/ 2/54	11.6
			9/15/54	3.80
			9/27/54	1.50
			10/27/54	1.81
			9/11/56	.62
			4/12/57	39.9
			5/10/57	e .38
			8/15/58	0
			9/16/58	0
			11/13/58	8.57
			8/ 4/59	0
			8/30/60	1.35
			8/11/61	1.26
			9/ 5/63	.03
			9/ 8/65	.11
			6/24/66	1.14
			7/14/66	0
			7/26/66	a .31
			8/10/66	.02
			8/26/66	.04
			9/12/66	.32
			10/10/66	.97
			6/ 7/67	2.25
			9/ 7/67	.71
1-3598.30	Onesquethaw Creek near Clarksville	at bridge on State Highway 32, 1.8 miles southeast of Clarksville. (Drainage area, 17.8 square miles.)	4/ 5/52	m 935
1-3598.40	Onesquethaw Creek near South Bethlehem	at bridge on Feura Bush Aqueduct Road, at Spawn Hollow, 1.1 miles west of South Bethlehem. (Drainage area, 28.1 square miles.)	12/11/53	m 3,720
			7/19/55	1.96
			8/17/61	1.58
			9/ 7/65	.45
1-3598.45	Onesquethaw Creek at South Bethlehem	at bridge on South Albany Road, 0.5 mile east of South Bethlehem, and 0.7 mile upstream from mouth.	7/19/55	r 3.02
			9/ 7/65	r .91
			10/21/65	a, r 19.9
1-3598.50	South Albany Creek at Jericho Bridge	at bridge on Jericho Road, at Jericho Bridge, and 0.85 mile west of Mallorys Corners.	9/ 7/65	0
			9/29/65	T
			10/21/65	.21

APPENDIX--Continued

Discharge measurements made at miscellaneous sites in the Vloman Kill and Coeymans Creek basins, Albany County, N. Y.

Station No.	Station name	Location	Measurements	
			Date	Discharge (cfs)
1-3598.55	South Albany Creek Tributary at South Albany	at bridge on South Albany Road, at South Albany, and 0.15 mile upstream from mouth.	9/ 7/65	e 0.03
			10/21/65	.12
1-3598.60	South Albany Creek Tributary No. 2 at South Albany	at bridge on South Albany Road, at South Albany, and 0.2 mile upstream from mouth.	9/ 7/65	[illegible]
			10/21/65	0
1-3598.70	South Albany Creek Tributary No. 3 at South Albany	at bridge on South Albany Road, 0.15 mile upstream from mouth, and 0.6 mile south of South Albany.	9/ 7/65	T
			10/21/65	T
1-3598.95	South Albany Creek near South Bethlehem	50 ft upstream from mouth and 1.05 miles northeast of South Bethlehem.	9/ 7/65	s .18
			9/29/65	s .81
			10/21/65	s .39
			6/24/66	s .39
			7/14/66	s .23
			7/26/66	s .32
			8/10/66	s .29
			8/26/66	s .23
			9/12/66	s .36
			10/10/66	s .59
			6/ 7/67	s 1.39
			9/ 7/67	s .40
1-3599	Coeymans Creek near South Bethlehem	at bridge on State Highway 396, 1.1 miles northeast of South Bethlehem. (Drainage area, 34.6 square miles.)	12/11/52	m 2,740
			7/18/55	r 3.25
			7/ 6/61	r 5.47
			8/17/61	r 2.98
			5/23/62	r 8.83
			7/ 7/62	r 2.70
			8/13/62	r 2.24
			6/27/63	r 5.12
			7/12/63	r 1.58
			9/ 5/63	r .72
			9/ 2/64	r 1.61
			9/ 7/65	r .82
			9/29/65	r 12.5
			10/21/65	a, r 13.5
			6/24/66	r 3.82
			7/14/66	r 2.13
			7/26/66	r 1.68
			8/10/66	r .89
			8/26/66	r 1.15
			9/12/66	r .91
			10/10/66	r 2.95
			6/ 7/67	r 16.8
			9/ 7/67	r 1.77
1-3599.03	Coeymans Creek near Selkirk	at bridge on Pictuay Road, 1 mile west of of Selkirk (complete-record gaging station since 8-28-67).	9/ 6/67	r 1.73
1-3599.05	Feuri Spruyt near South Bethlehem	200 ft upstream from mouth, and 1.5 miles southeast of South Bethlehem.	7/19/55	e .35
			9/ 9/65	.46
			9/29/65	1.77
			10/21/65	1.21
1-3599.07	Coeymans Creek near Selkirk	at bridge off Miller Road, 0.15 mile downstream from Feuri Spruyt and 1.5 miles southwest of Selkirk.	9/ 9/65	r 2.18
			9/29/65	r 17.8
			10/21/65	r 15.0
1-3599.10	Coeymans Creek near Coeymans	1.3 miles downstream from bridge on Pictouia Road and 2.0 miles north of Coeymans.	9/ 8/65	r 2.40
			6/24/66	r 4.96
			7/14/66	r 2.71
			7/26/66	r 2.96
			8/10/66	r 1.26
			8/26/66	r 1.55
			9/12/66	r 2.11
			10/10/66	r 6.82
			6/ 7/67	r 19.6
			9/ 7/67	r 1.98

Note.--All measurements made under base flow conditions unless otherwise noted.
- a Not base flow.
- e Estimated.
- m Peak discharge.
- r May include an unmeasured amount of inflow from city of Albany filtration plant entering Onesquethaw Creek downstream from station 1-3598.40.
- s May include sewer system effluent.
- T Trace.